



## A DUAL PRESSURE EULER STEAM TURBINE FOR INDUSTRIAL AND BUILDING APPLICATIONS

### INNOVATIVE DUAL PRESSURE TURBINE GENERATES ELECTRICAL POWER BY HARNESSING PREVIOUSLY WASTED ENERGY

#### Benefits

- Could save 4.7 billion Btu annually per 150 kW installation
- Could save 4.7 trillion Btu annually by 2010 from 1000 installations
- Reduces emissions of CO<sub>2</sub> and NO<sub>x</sub> by 50%
- Increases efficiency, thereby recovering energy
- Designed to operate with poor quality steam

#### Applications

This innovation will improve the efficiency of OIT Industries of the Future that use steam turbine mechanical drives and generators, as well as steam-driven HVAC systems in buildings.

#### Project Partners

NICE<sup>3</sup> Program  
Washington, DC

California Energy Commission  
Sacramento, CA

State of California Trade and Commerce Agency  
Sacramento, CA

Douglas Energy Company  
Placentia, CA

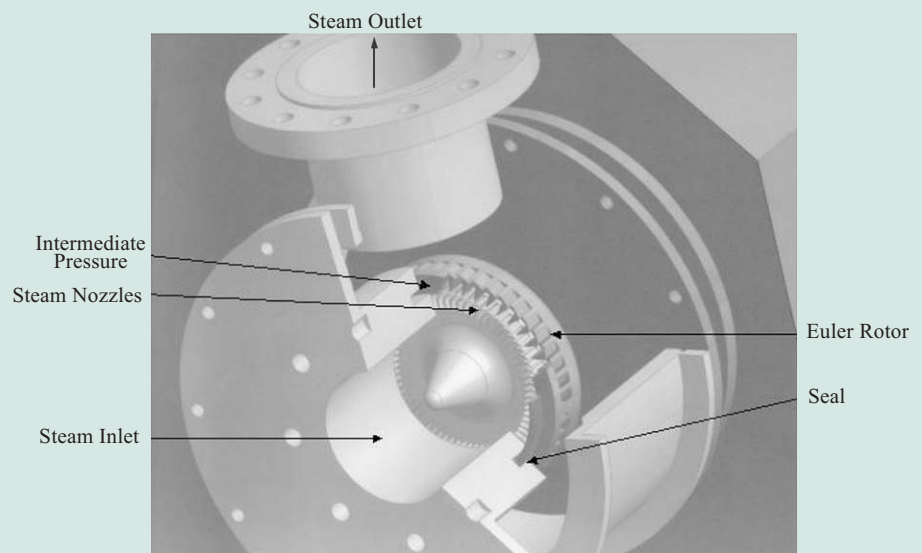
Carrier Corporation  
Syracuse, NY

Rolex Realty Company  
New York, NY

The single-stage steam turbine has been one of the most successful technologies applied to industry. However, since the average efficiency is only 40% most of the potential energy generated by this “back pressure” system is wasted. Doubling efficiency would reduce by half the steam flow needed to produce the required power output. Such a dramatic change would greatly reduce emissions while increasing the number of cost-effective applications for steam generation.

Douglas Energy, with assistance from the U.S. Department of Energy’s NICE<sup>3</sup> Program, the California Energy Commission, the State of California Trade and Commerce Agency, Carrier Corporation, and Rolex Corporation, is demonstrating a unique turbine system that dramatically improves generation efficiency. The dual pressure Euler steam turbine improves generation efficiency by using two power producing expansions with a single rugged rotor instead of the single power producing expansion of most industrial steam turbines.

#### DUAL PRESSURE EULER TURBINE



With development of its dual pressure Euler steam turbine, Douglas Energy can nearly double the efficiency of industrial steam turbine technology, allowing users to cut energy use and subsequent emissions in half.



## Project Description

**Goal:** Demonstrate a dual pressure Euler turbine, a more efficient, reliable, and less costly steam turbine. The demonstration unit will be installed at the Rolex Building in New York City where it will replace a pressure reduction valve and generate 150 kW of electricity from the energy currently wasted in the valve. The steam feeds an absorption chiller so the extra power will reduce the utility power required during the summer. It has been estimated that similar installations could reduce the total peak summer demand in Manhattan by more than 200 MW.

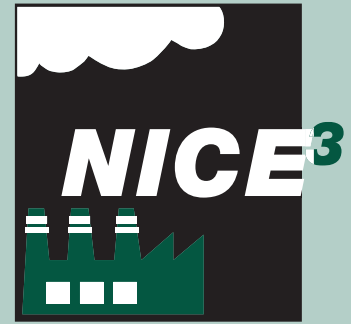
The original application for the single pressure Euler turbine was a water wheel, developed in 1754. Since then, the basic principle for this turbine has remained in place. The original technology is limited by the extent of the centrifugal pressure rise in the rotor, and the resulting velocity created by expansion through the rotor nozzles. The novel dual pressure turbine increases the reaction and power by lowering the rotor exit pressure. Harnessing this "reaction" energy allows the single pressure machine to be converted into a two-stage turbine; it becomes a combined impulse and reaction turbine with internal compression. Compared with traditional technology, turbine efficiency can be increased from an average of 40% to the 70-80% range.

## Progress and Milestones

- Design dual pressure Euler turbine and system.
- Manufacture the turbines and conduct spin and pressure tests.
- Manufacture the field package, install at a test facility, and operate at full steam conditions.
- Install the field package in the Rolex building and conduct performance tests.
- Conduct long term operation and monitor performance over time.
- Prepare final report and commercialize the turbine.
- Prepare commercialization reports.

## Economics and Commercial Potential

This technology could save 4.7 billion Btu of energy annually per 150 kW installation. A typical application in Manhattan could use ten 150-kW units. First sales of the technology are expected by 2003. Based on a 30% penetration of the letdown market by year 2010, 1000 operating units could save 4.7 trillion Btu annually. Continued market penetration by year 2020 could save 15.5 trillion Btu annually from operating 3,300 units.



**NICE<sup>3</sup> – National Industrial Competitiveness through Energy, Environment, and Economics:**  
An innovative, cost-sharing program to promote energy efficiency, clean production, and economic competitiveness in industry. This grant program provides funding to state and industry partnerships for projects that demonstrate advances in energy efficiency and clean production technologies. Awardees receive a one-time grant of up to \$525,000. Grants fund up to 50% of total project cost for up to 3 years.

For project information, contact:

### Lance Hays

President  
Douglas Energy Company  
181 W. Orangethorpe Avenue  
Suite D  
Placentia, CA 92870  
Phone: (714) 524-3338  
Fax: (714) 524-3341  
hays@douglasenergy.com

For more information about the NICE<sup>3</sup> Program, contact:

### Lisa Barnett

Program Manager  
NICE<sup>3</sup> Program  
Phone: (202) 586-2212  
Fax: (202) 586-7114  
lisa.barnett@ee.doe.gov

Visit our home page at  
[www.oit.doe.gov](http://www.oit.doe.gov)

Office of Industrial Technologies  
Energy Efficiency and  
Renewable Energy  
U.S. Department of Energy  
1000 Independence Avenue SW  
Washington, D.C. 20585-0121



Order # NICE<sup>3</sup> OT-17  
January 2002